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(54) **AUTOMATIC THERMAL PRINT ON DEMAND PRODUCE LABELER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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Related U.S. Application Data

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(60) Provisional application No. 62/060,267, filed on Oct. 6, 2014.

(51) **Int. Cl.**
B41J 25/304 (2006.01)
B41J 2/335 (2006.01)
B41J 3/407 (2006.01)

(52) **U.S. Cl.**
CPC ***B41J 2/335*** (2013.01); ***B41J 3/4075*** (2013.01)

(58) **Field of Classification Search**
CPC B41J 2/335; B41J 3/4075; B41J 25/304; B41J 25/308; B41J 25/3082; B41J 25/3084; B41J 25/3086
See application file for complete search history.

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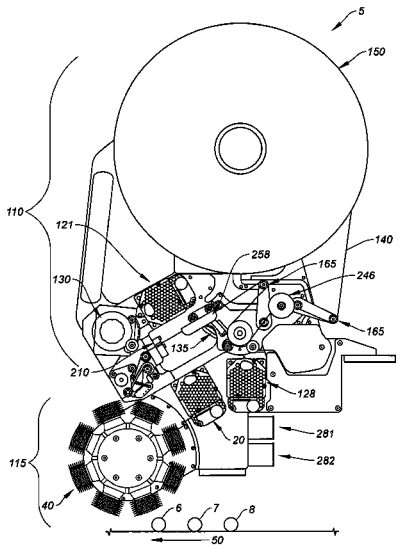
(74) *Attorney, Agent, or Firm* — Bruce H Johnsonbaugh

(57) **ABSTRACT**

An automatic, thermal print on demand labeler is provided. The thermal print head is placed above the axis of rotation of the rotary head, with a cylindrical platen mounted horizontally opposite the print head. A stripper pin is mounted below the platen; the pin is positioned very close to the print region of the print head. This positioning of components results in a label being printed and dispensed onto a bellow in one index of the multi-bellow rotary head. Independent direct gear drive trains are provided for the rotary head and label tape drive.

15 Claims, 10 Drawing Sheets



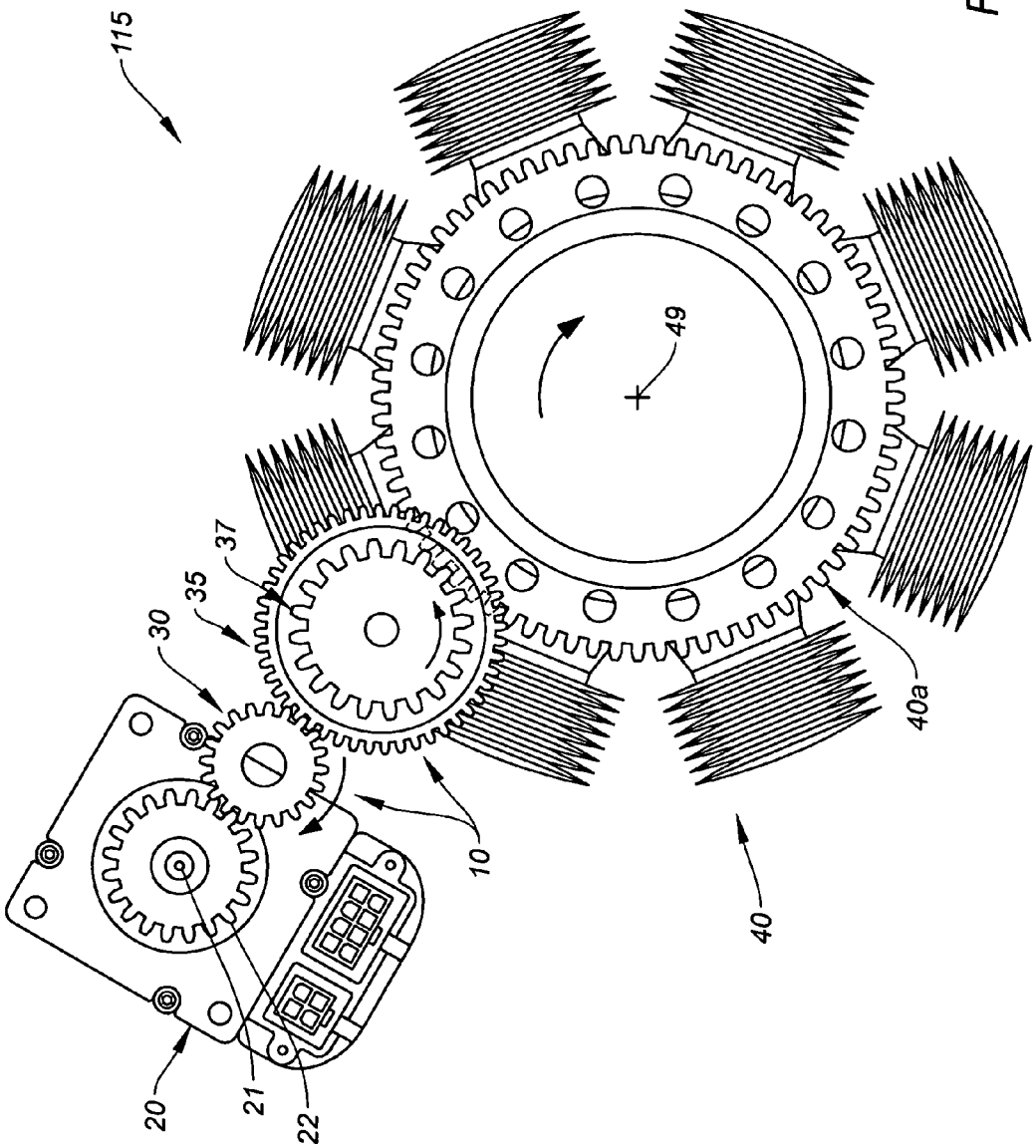


FIG. 1

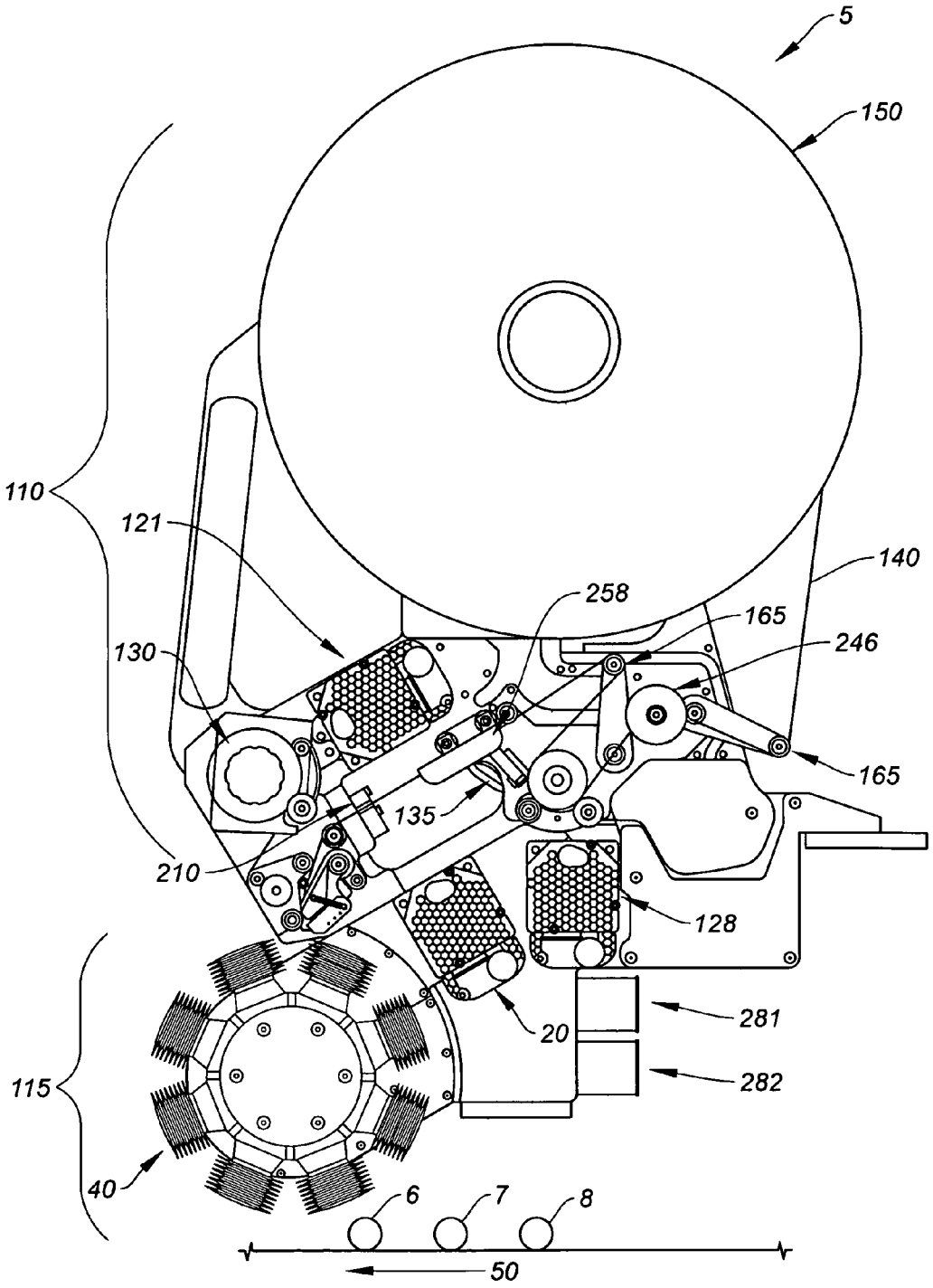

5
150
110
121
140
258
165
130
246
165
135
210
128
281
20
115
282
40
6
7
8
50

FIG. 2A

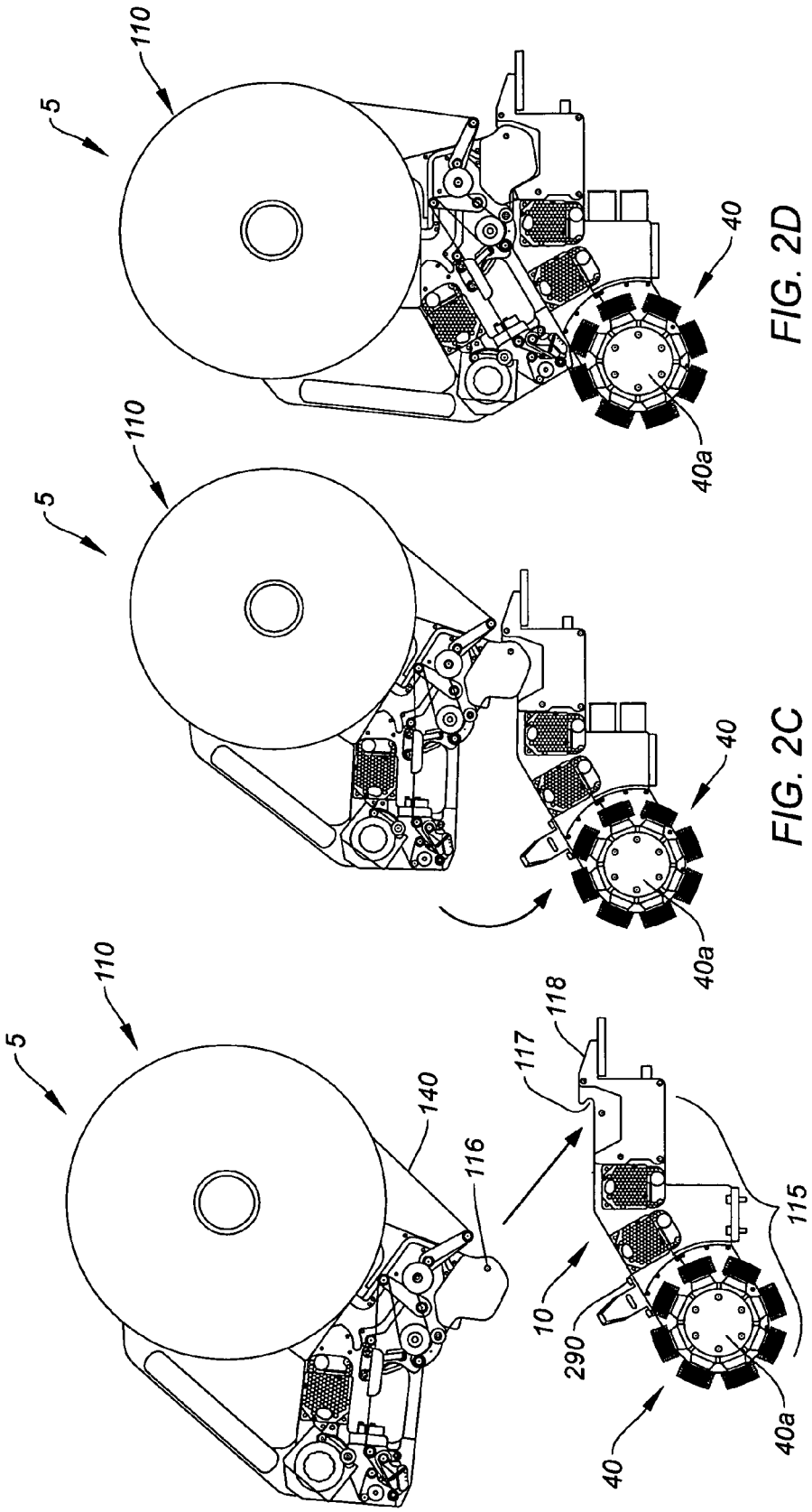


FIG. 2D

FIG. 2C

FIG. 2B

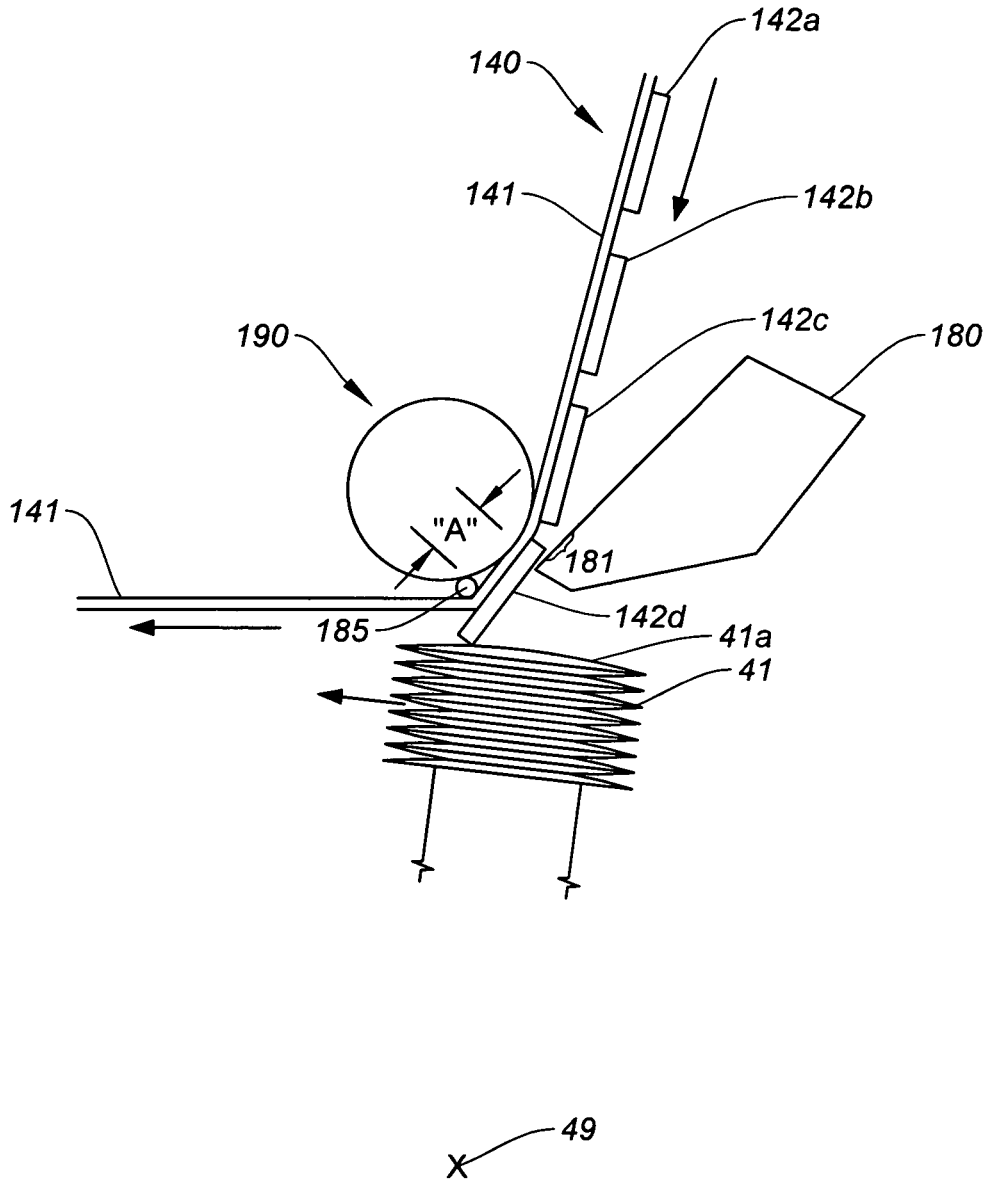


FIG. 3

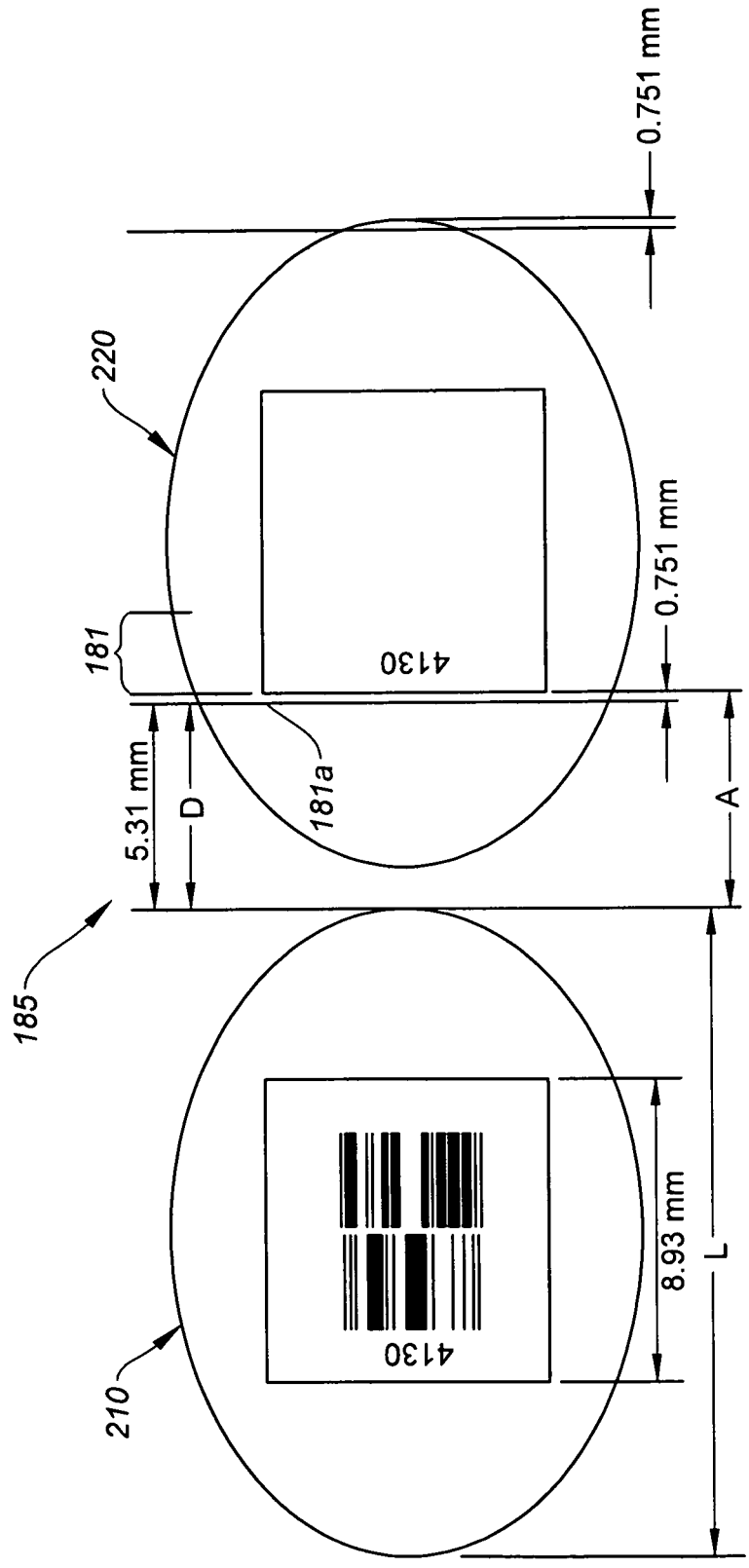


FIG. 4

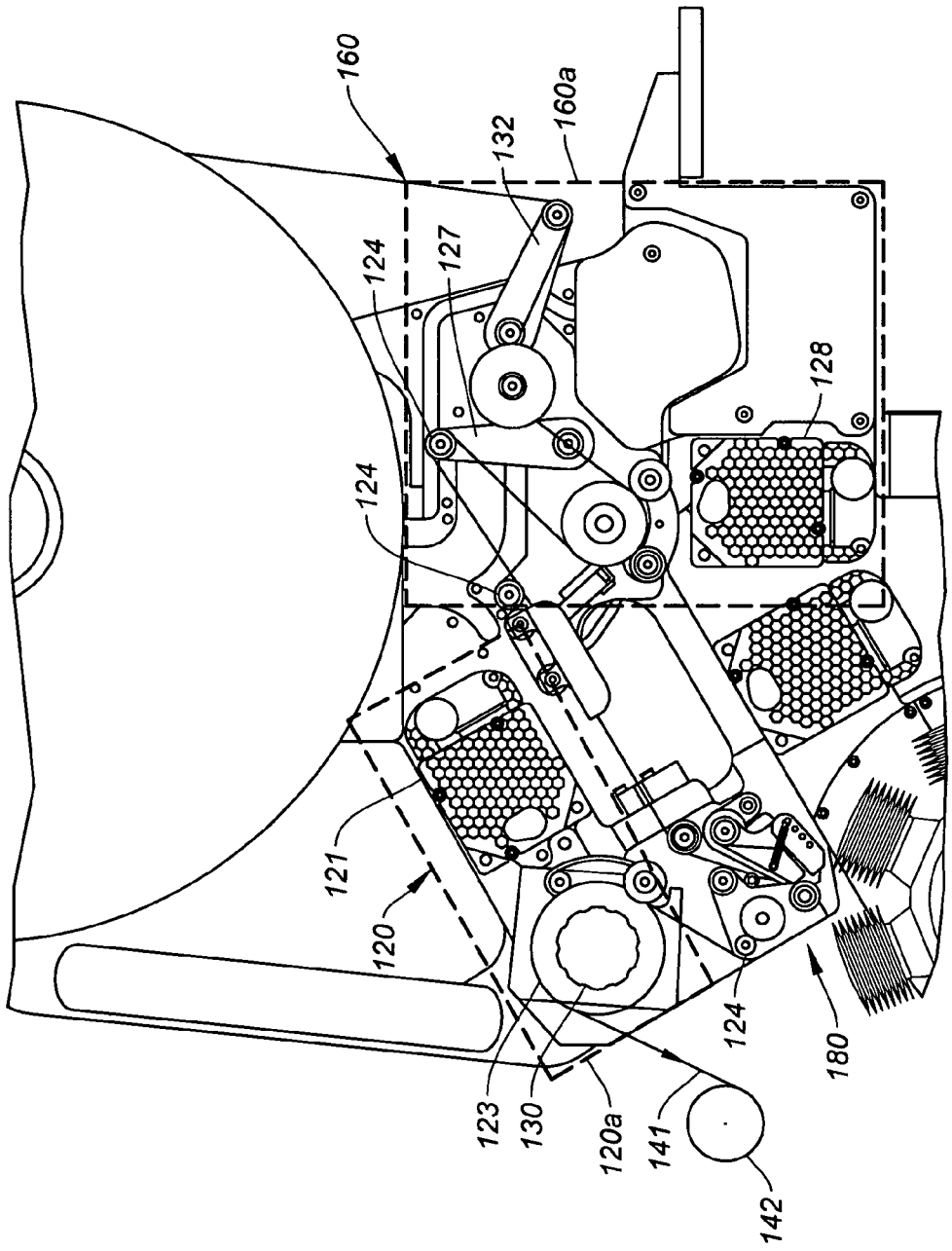

160
132
160a
124
127
128
124
121
120
123
130
120a
141
142
124
180

FIG. 5

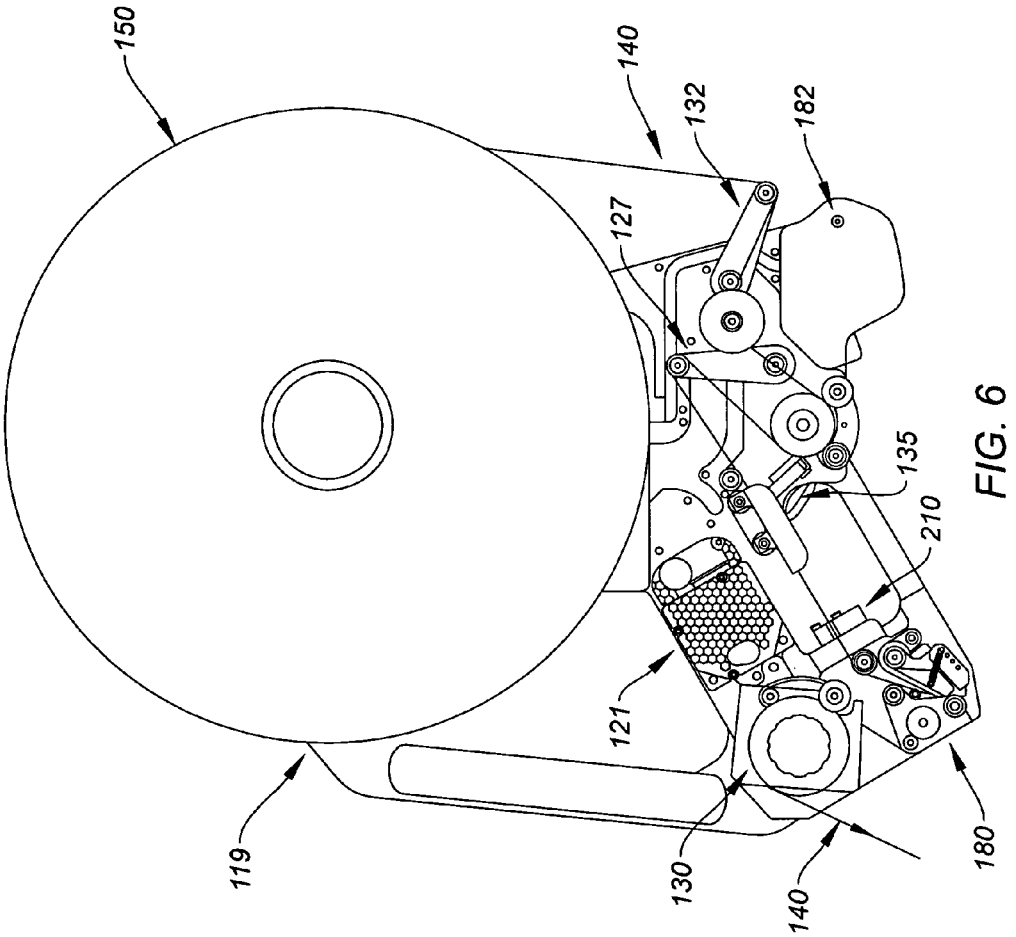


FIG. 6

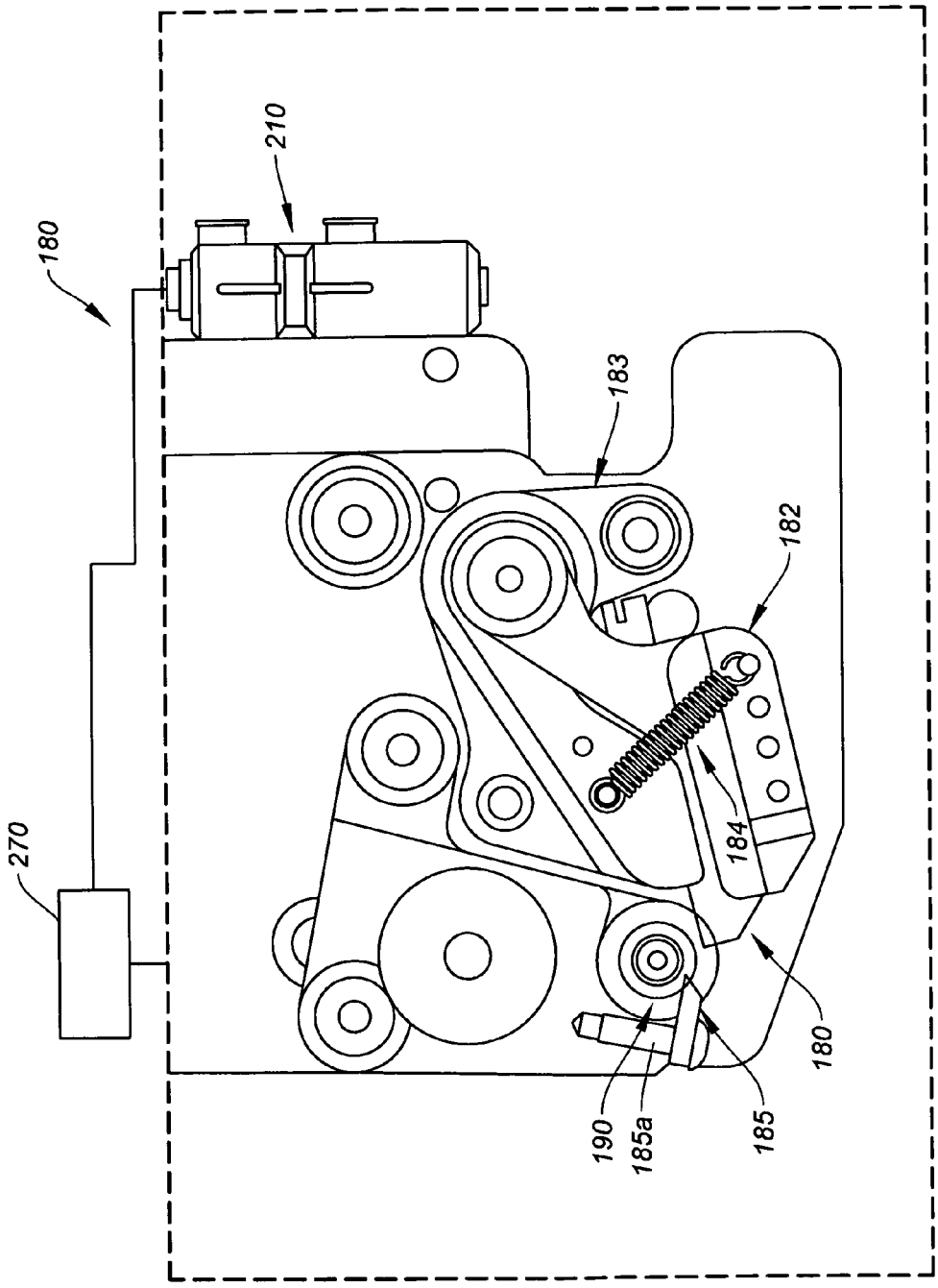


FIG. 7

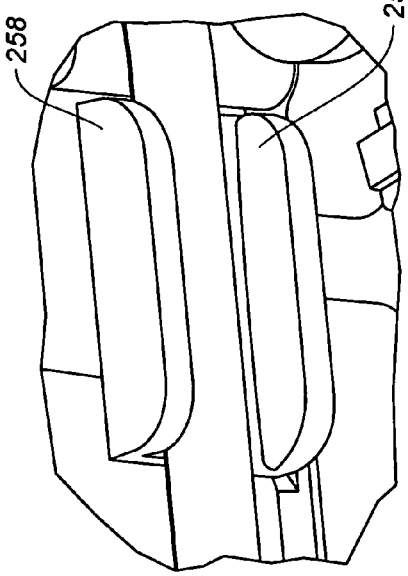


FIG. 8B

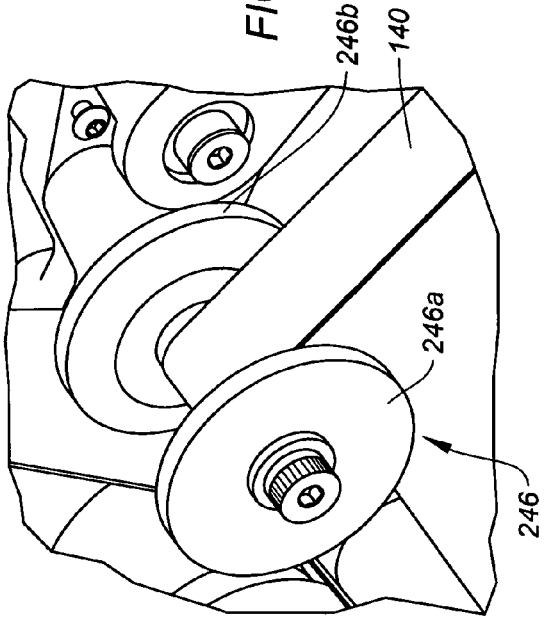


FIG. 8C

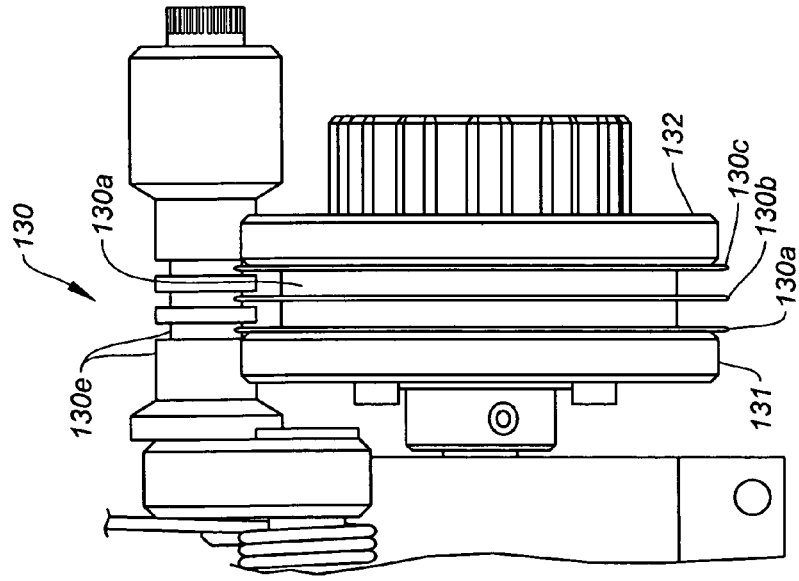


FIG. 8A

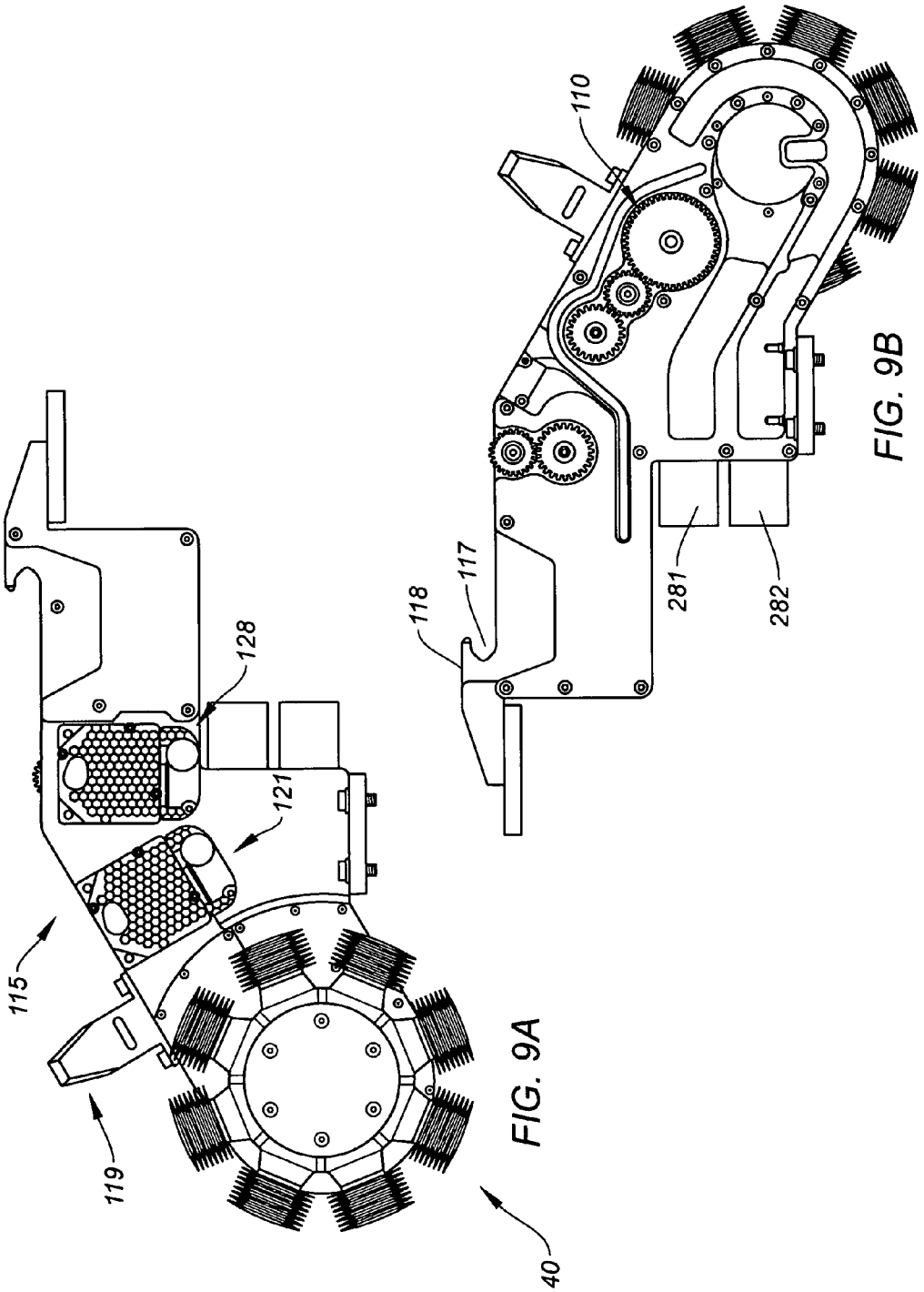


FIG. 9B

FIG. 9A

AUTOMATIC THERMAL PRINT ON DEMAND PRODUCE LABELER

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of and priority from U.S. provisional application Ser. No. 62/060,267 filed Oct. 6, 2014.

This application is a continuation-in-part of U.S. application Ser. No. 14/756,175 filed Aug. 12, 2015.

BACKGROUND

The demand for automatic, high speed produce labelers continues to rise worldwide. Similarly, the demand for relatively low cost and relatively high speed produce labelers continues to rise.

The present invention satisfies both of the above demands.

SUMMARY OF INVENTION

The present invention provides an automatic direct thermal image printing system capable of printing on demand labels at a reasonable cost and at reasonably high speeds expected to be approximately 240 to 840 labels per minute per lane. The phrase "print on demand" means that the labeler senses a characteristic, such as size, of each individual produce item as the item approaches the printer, and the labeler prints and applies a specific variable label for each item. The concept of automatic, variable "print and apply" produce labeling is taught in U.S. Pat. Nos. 7,168,472 and 8,570,356, both of which are incorporated herein by reference as though set forth in full. The teachings of those two patents are not repeated here for the sake of brevity.

The new system disclosed below provides a print-head location relative to the label stripping location whereby a label is printed and dispensed onto a bellow in one index of the rotary head. This placement minimizes and optimizes the distance between the print-head and label stripping point.

The new system also provides improved and independent drive mechanisms for the rotary head and the label carrier tape (or strip). The rotary head is driven by an improved and simplified direct gear drive system using a dedicated stepper motor and three directly driven gears. This drive system eliminates more than half the moving parts of typical prior art rotary head drives. The present system also provides an independent drive system for the label carrier tape. This separate tape drive system is "decoupled" from the rotary head drive.

Other improved features shown and described below include:

1) A label detection sensor.
2) Improved tape centering.
3) Extended bellow life.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic illustration of the label applicator **115** with its direct gear drive train **10** for the rotary head **40**;

FIG. **2**A is a schematic showing the rotary head in position below the label cassette reel and drive;

FIGS. **2**B, **2**C and **2**D illustrate how the detachable label cassette is hingedly attached to label applicator **115**.

FIG. **3** is a concept sketch, not to scale, illustrating the novel placement of critical components of the system;

FIG. **4** is a schematic showing the relative sizes and placement of labels, print head and stripper pin;

FIG. **5** is an overview schematic of the label carrier strip (or label tape drive) and tensioning system;

FIG. **6** is a schematic of the removable label cassette, separated from the label applicator;

FIG. **7** illustrates the thermal printer components;

FIGS. **8**A-**8**C illustrate the label tape centering components; and

FIGS. **9**A-**9**B illustrate the overall layout of the label applicator **115**, which includes rotary head **40** and its direct gear drive and drive motor.

DETAILED DESCRIPTION OF DRAWINGS

FIGS. **1**, **2**A-**2**D illustrate the general layout of the automatic labeling machine, shown generally as **5** in FIGS. **2**A-**2**D. The two major components are the label applicator **115** (FIGS. **1** and **2**B) and a detachable label cassette **110** (FIG. **2**B). Detachable label cassette **110** as shown in FIGS. **2**B-**2**D is hingedly connected to label applicator **115** by pin **116** at the base of label cassette **110** engaging recess **117** formed at the top of label applicator **115** in knuckle **118**. FIGS. **2**C and **2**D show how label cassette **110** is hingedly and detachably mounted to label applicator **115**. Pin **116** is first slipped into recess **117** as shown in FIG. **2**C, and then label cassette **110** is rotated downwardly into engagement with label applicator **115** as shown in FIG. **2**D. The rotary head **40** together with its drive motor **20** and gear train **10** are referred to herein as the label applicator **115**. The label applicator has a plurality of preferably 8 bellows carried on an indexable rotary head **40***a*. As shown in FIG. **1**, rotary head **40** has 8 index positions, spaced equally every 45 degrees around the horizontal axis of rotation **49** of rotary head **40**. As is known generally in the art, individual labels from label carrier strip **140** (FIG. **2**A) are transferred onto the tip of a single bellow, and thereafter onto individual items of produce **6-8** as shown in FIG. **2**A moving in the direction of arrow **50**.

FIG. **1** is a schematic illustrating the rotary head direct gear drive train shown generally as **10**. A stepper motor **20** has an output shaft **21** which carries a preferably plastic gear **22**, rotating in a counter-clockwise direction as viewed in FIG. **1**. Gear **22** preferably has 30 teeth. Idler gear **30** has 25 teeth preferably and is driven directly by motor output gear **22**. Idler gear **30** is preferably plastic and rotates in a clockwise direction as viewed in FIG. **1**. Idler gear **30**, in turn, drives gear **35**, wherein gear **35** has 50 teeth. Gear **37** rotates with gear **35**; gear **37** has 24 teeth. Both gears **35** and **37** rotate counter clockwise in FIG. **1**.

An eight bellow rotary head **40** is driven by gear **37**. The overall or final gear ratio of the drive **10** is 5 to 1, with 5 rotations of gear **22** causing one full rotation of rotary head **40**.

Produce items **6-8** (FIG. **2**A) are singulated and conveyed below turret **40** in the direction of arrow **50**. It is significant to note that rotary head **40** may carry either eight bellows as shown in FIG. **1** or six bellows (not shown). An eight bellow rotary head operates at a 33% higher labeling speed than a six bellow turret.

FIG. **2**A illustrates the rotary head **40** of FIG. **1** in position below detachable label cassette **110** which includes the label carrier strip (or label tape) reel **150** and tape drive mechanism, described further below.

FIG. **2**A shows a label tape drive stepper motor **121** that drives a label tape drive hub or wheel **130** through a drive train not visible in FIG. **2**A. As drive hub **130** rotates

counter-clockwise, it pulls label tape (or label carrier strip) **140** off of label reel **150** and through the tensioning and printing mechanisms of FIG. **2**A as described below in further detail.

FIG. **3** is a "concept" sketch, not to scale, illustrating the novel and significant placement of thermal print head **180** and label stripper pin **185**. Print head **180** is positioned so that its thermal printing region or area **181** is within twenty degrees, plus or minus, from being vertically aligned with the horizontal axis of rotation **49** of rotary head **40**, of which only a single bellow **41** is shown in FIG. **3** for clarity. A rotatable platen **190** is positioned horizontally opposite from print head **180**.

Thermal print region **181** is positioned between thermal print head **180** and cylindrical, rotating platen **190**. The label carrier strip (or label tape) **140** is pulled from the label (or tape) reel **150** (FIG. **2**) and is caused to move downwardly at an angle of less than 20 degrees from the vertical, between print head **180** and platen **190**. Label carrier strip **140** includes a liner **141** and a plurality of thermographic labels **142**; only 4 labels **142***a*-**142***d* are shown in FIG. **3** for clarity. As the label strip **140** is pulled from tape reel **150** (FIG. **2**A), thermographic label **142***d* is separated from liner **141** by stripper pin **185** and moves downwardly into contact with the top surface **41***a* of bellow **41** (FIG. **3**). The top **41***a* of bellow **41** moves counter-clockwise in FIG. **3** at the same speed as label carrier strip **140**. Stripper pin **185** is located below platen **190** and as close as possible to print region **181** print head **180**.

Thermal print head **180** has a thermal print region **181** which transfers heat, for example from a laser diode array onto each of thermographic labels **142***a*-**142***d* as the labels move past region **181**. As shown in FIG. **3**, label **142***d* has been nearly completely printed, is partially stripped from liner **141** by stripper pin **185** and has made contact with the top **41***a* of bellow **41**. As bellow **41** moves counterclockwise from the position shown in FIG. **3**, label **142***d* is drawn down fully onto the top surface **41***a* of bellow **41** by a vacuum system known in the art created inside bellow **41**. The novelty of the design is that a label such as **142***d* is printed (as it passes through print region **181**) and dispensed (as it is stripped from liner **141** by stripper pin **185**) onto a bellow (**41**) in one index of the rotary head (as bellow **41** is indexed through a single index of a 45 degree angle for an 8 bellow rotary head). This novel result is created by the short and sufficiently small or short distance "A" between the leading (or lower) edge **181***a* (FIG. **4**) of print region **181** and stripper pin **185**, and by the small or short distance (less than 10 mm) between the top **41***a* of bellow **41** and stripper pin **185**. Distance "A" is preferably less than 10 mm, and most preferably 6 mm or less.

A significant advantage of the configuration shown in FIG. **3** is that each label is printed before it is stripped from liner **141**, before it is applied to a bellow, and as it is held against a platen, resulting in a high clarity image. A further advantage is that the configuration lends itself to increased serviceability of the print head.

As shown in FIG. **3**, the top **41***a* of bellow **41** (and all bellows) is positioned as close as possible to stripping pin **185** to allow each label to contact the bellow before the label is fully stripped from liner **141**. Each label is printed, at least partially, before it begins to be stripped by stripper pin **185**. Bellow life is extended because each bellow does not run against a stripper pin or stripper plate; bellows in the present system do not contact the label stripper.

A constant stream of air is blown horizontally against label **42***d* (and all labels) from left to right in FIG. **3** (not shown for clarity) as it is stripped from the label liner **141**. This air assists helps to prevent the label from wrapping around the stripping pin **185** and following the liner **141**.

FIG. **4** illustrates an illustration of two labels **210** and **220** shown in positions relative to the location of stripper pin **185** and print region **181** of print head **180**. Labels **210** and **220** are moving to the left in FIG. **4**; label **210** has been printed (by print head **180** transferring heat by a laser diode array, for example, to each thermographic label to apply a code, such as a bar code, to each label) and stripped from liner **141**; label **220** is entering print region **181** and has only a portion of the bar code printed on it. Each label is printed as it is urged against platen **190** and before it is transferred to a bellow. It is significant to note that each of labels **210** and **220** has a length L of approximately 20 mm and that the distance between the leading edge **181***a* (FIG. **4**) of print region **181** and stripper pin **185** is only about 6 mm. In the preferred embodiment shown in FIG. **4**, each label has a length L which is greater than the distance D between the leading edge **181***a* of print region **181** and stripper pin **185**. In the most preferred embodiment, the distance L is more than three times greater than the distance D. Each label preferably has a length L greater than the distance between the leading edge **181***a* of thermal print region **181** and the top of a bellow when said bellow is at its closest point to stripping pin **185**.

FIGS. **5** and **6** illustrate the label carrier strip (or label tape) drive system shown generally as **120** and positioned inside dashed line **120***a* in FIG. **5**. FIG. **5** also shows the tape tensioning system shown generally as **160** and positioned within dashed line **160***a*.

The drive motor for the label carrier strip **140** in FIG. **5** is a stepper motor **121**. Motor **121** causes drive wheel **122** and drive roller **123** to rotate, creating tension in label carrier strip **140**. Rollers **124** together with tension arm **127** keep the label carrier strip **140** in tension and help to pull the label carrier strip **140** without over-pulling, which results in the label carrier strip **140** unwinding too far. An optical tension sensor **135** (FIG. **6**) measures the preload on tension arm **127** (FIG. **5**) and commands the tension motor **128** to release label carrier strip **140** as necessary to keep the label carrier strip **140** tension at a software controlled level. The label carrier strip **140** is also tensioned dynamically by varying the acceleration profiles of the drive stepper motor **121** and tension motor **128**, causing the inertia of tension arm **127** to add tension to strip **140**. The tension motor **128** primes the tape **140** for the drive (or index) motor **121** by buffering the motor **121** from any tape reel dependent effects, causing the loading on the motor **121** to be similar from label to label. It is also important to maintain tension in strip **140** from the print head **180** to the drive hub **130**; this helps provide good print quality and prevents breaking or tearing of strip **140**. Tension motor **128** drives in parallel with drive motor **121**. Tension motor **128** provides the proper tension to the label carrier strip **140** for the strip or tape **140** to drive through while providing the proper tension to strip labels from the carrier strip.

Tensioner arm **127** maintains a constant tension in label tape **140**. Locating the label tape drive hub **130** downstream of the tensioning and printing mechanisms provides a relatively constant tension on label tape **140**, reducing tearing of the tape and resulting labeling down time.

An optional feature is a backup roll **142** (FIG. **5**) onto which the liner **141** is wound.

As shown best in FIG. **7**, stripper pin **185** is rotatably carried by a cylindrical mounting pin **185***a*. Stripper pin **185**

is readily rotated away from platen **190** to ease the lacing of label carrier strip **140**, and to facilitate cleaning and servicing print head **180**.

FIG. **7** illustrates the components of the printer assembly **180**. In use, the assembly **180** shown in FIG. **7** is rotated to the position shown in FIGS. **2**, **3** and **5**. Print head **180** may be a known direct thermal print-head scan available from Gulton (www.gulton.com) or Kyocera (http://global.kyocera.com). Print head **180** is mounted inside a print head hinge **182**. The print head hinge **182** floats in an elongated hole in print head frame **183**, allowing print head **180** to rotate to the angle of the surface of platen **190** to ensure good contact. Two extension springs **184** (only one of which is visible in FIG. **7**) apply proper and even print head pressure on platen **190** (FIG. **3**). The platen is captured in a platen rotator which can swivel away from the print head **180** for ease of lacing while reducing the chance of print head damage.

A significant aspect of the improved label dispensing technique is that a label release (or stripping) pin **185** is used, as opposed to a typical stripper plate, to separate each label from the carrier strip. This improved design extends the life of the bellows, since the bellows do not frictionally run against the bottom of a typical stripper plate.

A label detection sensor **210** (FIGS. **6** and **7**) is positioned adjacent to and upstream from print head **180**. Sensor **210** signals the print head controller **270** to accelerate, fire and then decelerate.

FIG. **8**A-**8**C illustrates how the improved centering system acts on the label carrier tape **140** to center the tape as it moves through the label cassette **110** to drive hub **130** (FIG. **2**A). Drive hub **130** (FIGS. **2**A and **8**A) includes a spiked center wheel **130***a* having three rows of radially extending spikes **130***b*, **30***c* and **130***d*. Spikes **130***a*-**130***c* pierce the liner **141** (not shown). A grooved shaft **130***e* above wheel **130***a* prevents liner **141** from coming off wheel **130***a*. Wheel **130***a* and spikes **130***a*-**130***c* are held together by discs **131**, **132**.

As the label carrier strip **140** is pulled off reel **150** by drive hub **130**, it is centered by guide roller **246** (FIG. **2**A). Guide roller **246** has centering hubs **246***a*, **246***b* which keep label carrier strip **140** centered. The tape **140** is also centered by guide channel **258**, **259** (FIGS. **2**A, **8**B). This centering device allows for scallop tape label strips, straight edge label strips, etc., which is important in the manufacturing of labels by allowing labels to be nested and therefore maximizing laminate utilization (a significant decrease in laminate waste). The centering device is an improvement over the current design which uses a scalloped wheel, which must match the specific scallop design.

FIGS. **9**A-**9**B illustrate the overall layout of label applicator **115**. FIG. **9**B shows the reverse side of applicator **115** shown in FIG. **9**A.

A user interface **119** is included with buttons to advance rotary head position relative to label dispensing location. This allows for label dispensing to be easily adjusted for best performance.

Pneumatic inlets **281** and **281** provide vacuum and air pressure as needed to actuate the bellows.

Power for the stepping motors **20**, **121** and **128** (48 VDC) flows into the printed circuit board of applicator **115** and into a blind mating interconnection by a microlimit switch **290** (FIG. **2**B) which detects the presence of a properly positioned cassette. This is a safety means that protects both operators and equipment.

The foregoing description of the invention has been presented for purposes of illustration and description and is not intended to be exhaustive or to limit the invention to the precise form disclosed. Modifications and variations are possible in light of the above teaching. The embodiments were chosen and described to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best use the invention in various embodiments and with various modifications suited to the particular use contemplated.

We claim:

1. An automatic, thermal print on demand, labeling machine used to apply thermographic labels to produce, wherein a label applicator having a plurality of bellows carried on an indexable rotary head is utilized to transfer individual thermographic labels from a label carrier strip, onto the tip of a single bellow, and thereafter onto individual items of produce wherein said rotary head has a horizontal axis of rotation, comprising:

a thermal print head positioned above said axis of rotation of said rotary head,

a rotatable, cylindrical platen positioned above said axis of rotation of said rotary head and opposite said thermal print head

means for moving said label carrier strip downwardly between said platen and said thermal print head

a thermal print region between said thermal print head and said platen, at which region said thermal print head transfers heat to each of said thermographic labels to apply a code to said labels

a label stripper pin positioned below said rotating platen, said label stripper pin being positioned a distance from said thermal print region wherein said distance is sufficiently small that a label is printed and dispensed onto a bellow in one index of said rotary head.

2. The apparatus of claim **1** wherein each of said labels is printed before it is transferred to one of said bellows.

3. The apparatus of claim **1** wherein the printing of each of said labels is begun before said label is stripped from said label carrier strip.

4. The apparatus of claim **1** wherein each of said labels has a length greater than said distance between said label stripper pin and said thermal print region.

5. The apparatus of claim **4** wherein each of said labels has a length greater than the distance between said thermal print region and the top of a bellow when said bellow is at its closest point to said stripping pin.

6. The apparatus of claim **1** wherein said thermal printer is positioned so that said thermal print region is located within plus or minus 20 degrees of being vertically aligned with said axis of rotation of said rotary head.

7. The apparatus of claim **1** wherein said indexable rotary head is driven by a first, dedicated stepper motor through a direct, clutchless gear drive.

8. The apparatus of claim **7** wherein said means for moving said label carrier strip comprises a label cassette detachable from said label applicator, and a second, dedicated stepper motor which operates independently of said first stepper motor.

9. The apparatus of claim **8** further comprising a plurality of rollers wherein said label carrier strip passes over said plurality of rollers, further comprising centering means for centering said label carrier strip on said rollers.

10. The apparatus of claim **8** further comprising tensioning means for said label carrier strip.

11. The apparatus of claim **9** wherein said tensioning means comprises a tensioning motor which drives in parallel with said means for moving said label carrier strip, wherein said tensioning motor provides proper tension to said label

carrier strip for said label carrier strip to drive through while providing proper tension to label carrier strip to strip labels from said label carrier strip.

12. The apparatus of claim **8** further comprising safety means, wherein said safety means includes a microlimit switch that restricts power in the absence of a properly positioned label cassette.

13. The apparatus of claim **1** further comprising a print head controller and label detection means to detect the presence of a label approaching said print head and to signal said print head controller to actuate said print head, wherein said label detection means is mounted adjacent to and upstream of said print head.

14. The apparatus of claim **1** further comprising a cylindrical mounting pin which carries said label stripper pin.

15. The apparatus of claim **14** wherein said label stripper pin is rotatable on said cylindrical mounting pin to facilitate servicing of said print head and lacing of said label carrier strip.

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